cavity has its analogue in that of the bellows (*d*). The elastic reservoir, together with the tubes, corresponds to the systemic arteries, the gas-bag connected with the tube *f* (the capillaries) to the systemic veins; and the tube *g* to the coronary arteries, which supply the muscular tissue of the heart with nutrient blood, just as it does the boiler by means of the burner *h*. This, however, does not show that the pumping power of the heart varies directly as the blood-pressure; that such is the case depends on the opportunity offered by the sphygmograph-trace for the estimation of the length of the ventricular systole under different circumstances. Each beat or revotion of the heart is divided into two main parts—(1) the period of contraction or systole, and (2) the period of repose or diastole. The former of these occupies the interval between the commencement of the primary rise and that of the dicrotic rise in the sphygmograph trace; the latter from the dicrotic rise to the commencement of the succeeding primary rise. In all good tracings from healthy pulses these two points, the primary and dicrotic rises, are readily found; and their relative lengths can be estimated with great accuracy. A large number of measurements have enabled me to prove that *the relative lengths of the systolic and diastolic portions of the pulse-trace do not vary for any given pulse-rate.* But, as will be granted by most physiologists who have worked at the subject, *the blood-pressure in the arteries is quite independent of the pulse-rate.* Consequently the heart may be doing very different amounts of work without any variation in the pulse-rate, which is the same thing as saying, with the same length of systole; which makes it evident that, as in the above-described engine, *the force of the cardiac muscular contraction varies directly as the blood-pressure*, knowing what we do about the flow of fluids through capillary tubes, and the capacity of the arterial system under different degrees of blood-pressure.

The sphygmograph trace tells us more than this. Though the length of the systolic portion of the beat does not change with any given pulse-rate, nevertheless it does so greatly with different rapidities of pulse; my observations showing that the length of the systole varies as the cube root of the whole beat, being found from the equation $xy' = 47\sqrt[3]{x}$ when $x =$ the pulse-rate and $y' =$ the ratio borne by the systole to the whole beat. From this no other inference can be drawn than that the length of the diastole, or period of cardiac rest, during which fresh blood is circulating through the ventricular walls, must modify the contractile force of its muscular substance. The exact extent of this influence can be more readily estimated by a study of the cardiograph trace, which is obtained by applying the sphygmograph to the side of the chest at any spot where the pulsations of the heart are to be felt. It may, from the thus obtained curves, be demonstrated that if not exactly, approximately, at least, *the nutrition of the heart's walls must vary as the square-root of the length of the diastolic period.*[*]

There is much, therefore, as I hope I have been able to show, to be learned respecting the action of the heart from measurement of sphygmograph tracings, and it is scarcely too bold to extend the generalisation to the properties of muscular tissue generally; for the fact that each beat depends entirely for its efficiency on the peculiarities in the blood-pressure and the duration of the previous diastole, removes all complications as to incompleteness of exhaustion, and all doubts as to the exact amount of work done by the muscular fibres themselves of that most perfect of engines, whose extreme perfection enables it to complete in most of us something like 750,000 beats in a week, and nearly thirty thousand million revolutions in a person by the time he is seventy years of age.

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[*] *Journal of Anatomy and Physiology*, May and November, 1873.

DR. VON MIKLUCHO MACLAY'S RESEARCHES AMONG THE PAPUANS[*]

WHEN lately at Buitenrovg—the scarcely euphonious equivalent of the "Sans Souci" of a former English Governor of Java—we had the good fortune to make the acquaintance of the owner of a name, whose peculiarity, no less than fame, has rendered it familiar to every biologist.

The friends—and we are sure they must be numerous—of Dr. Miklucho Maclay will regret to hear that he is determined, in spite of an aguish fever which still clings to him, and of, it is feared, some serious implication of the liver, to start again in a few days for the scene of his recent labours—the east coast of New Guinea, where he had previously spent fifteen months in close intercourse with the natives.

On September 19, 1871, the Russian corvette *Vitias* cast anchor in Astrolabe Gulf, and Dr. Maclay landed with two servants, one a Polynesian, the other a Swede. After a hut of very modest dimensions[†] had been built for him by the ship's carpenter, the *Vitias* weighed anchor on the 26th, and departed.

Dr. Maclay was soon left practically alone, and dependent entirely upon himself, for the Polynesian servant died early in December of a chronic fever which he had when he started, and the Swede soon followed suit, with the exception, that he did not die, but by constant ailing was a source of much encumbrance to his master.

As the natives were very distrustful, scarcely answering any questions, Dr. Maclay did not make much progress with the essential task of learning the language. Not only, however, were they suspicious, but determined to discourage the presence of the stranger by shooting arrows close to his head and neck, and pressing their spears so hard against his teeth, that he was constrained to open his mouth. Finding that he did not only not take the least notice of these annoyances, but that all his actions toward them were good (for, he being a doctor, his utility in the economy of the community was soon discovered), they concluded that he was no ordinary mortal, but that he was the veritable man-in-the-moon ("Kâramtâmo"), and paid him due respect accordingly.

As there were footpaths only in the neighbourhood of the villages, and as these latter were never found at a greater elevation than 1,500 feet, Dr. Maclay had some difficulty in making expeditions without guides, which at first were difficult to procure.

During his stay in New Guinea Dr. Maclay studied the inhabitants of the whole coast of Astrolabe Gulf; the people of the mountains round the gulf, and the dwellers on the islands near Cape Duperré, one of the boundaries of the gulf, who lived a life of such perfect peace that he called the islands "the Archipelago of Contentment."[‡] The inhabitants, too, of Dampier Island (Kar-kar) paid him visits. The inhabitants of "Maclay Coast," by which name Dr. Maclay proposes to call the coast skirting the edge of the Astrolabe Gulf, were of especial interest, as it seems that they have never been in intercourse with any civilised people, for not only were all their tools and weapons made out of stone, wood, or bone, but no trace of any European article could be found among them. These people treasured up, or exchanged as valuable, the smallest trifles which were given them, *e.g.* fragments of broken bottles, with which they shaved themselves, as a substitute for flint, or the sharp edges of grasses.

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[*] "Anthropologische Bemerkungen ueber die Papuas der Maclay Küste in Neu Guinea." Reprint from the *Naturkundig Tijdschrift voor Nederlandsch Indie Deel* xxxiii. *Mijn Verblijf aan de Oostkust van Nieuw Guinea. Ibid.* (Batavia, 1873).

[†] Only 7 feet broad, and 14 feet long, and divided by a screen of sailcloth into two rooms, one for his servants, the other for himself. The hut was situated on the south coast of Astrolabe Gulf, midway between the two capes, its boundaries.

[‡] "Archipel der zufriedenen Menschen."

Dr. Maclay told us of one curious custom which he does not mention in either of the two papers referred to in the note. The Papuans, though they know how to produce fire by rubbing together two pieces of wood, do not do this when they require this agent, but always carry their fire literally about with them, either trailing a lighted stick after them as they walk, or placing the same under their beds when they sleep.

Dr. Maclay, despite much pains, was only able to collect ten skulls, and only two out of these had the lower jaw, for the natives preserve this with great veneration, while the skull itself is thrown into the neighbouring jungle as a thing of no worth. The skull of the Papuans of Maclay coast is "dolicho-cephalic." The superciliary eminences are frequently very strongly developed The maxillary region is prognathous, so that the upper teeth project considerably beyond those of the mandible. The Papuans are of middle stature, the females being considerably smaller than the males, but are strong and well built.

Contrary to what has been written, there is no roughness of skin considerable enough to constitute a race characteristic ; which may be largely accounted for by the custom of smearing the bodies with a kind of earth, and to the frequency of psoriasis ("masso"). The colour of the skin too is in general of a light chocolate brown, and not of a bluish-black colour as has been previously asserted. The inhabitants of New Ireland, an island not far distant, have, on the other hand, a comparatively dark skin. The scars of slight wounds, *e.g.* such as are made with a red-hot coal, are somewhat darker than the surrounding skin, while deep wounds, which are of not infrequent occurrence, leave behind them scars almost white in colour.

After a series of very careful observations, made as well upon shaven as upon well-covered scalps, Dr. Maclay concludes that the hair is not naturally disposed, as has been represented, in tufts or clumps, but grows just as it would upon the head of a European. The length of the hair, too, varies in different individuals, for while one man is fain to cover his bald pate with a cuscus,* another is proud to display a "gatessi," which luxuriantly covers his shoulders.†

The natural colour of the hair is dull black, but this is marked, after the period of childhood, by a black ("kuma") or red ("surru") dye. The hair of children is covered with a wash of ashes and water for protection against lice ; this hardens into a thick crust. In the case of males this is continued till the time of circumcision, after which period much care is bestowed upon the coiffure. The women, oddly enough, expend no pains upon the arrangement of their hair. The eye-brows are generally shaven, and the hairs of the beard are either shaven or plucked out in the young men, but are permitted to grow among adults.

The general hair-growth upon the body seems to be more scanty than it is among the Caucasian races. Though hair is never seen on the back of the hands, it sometimes grows pretty thickly along the line of the vertebral column, and is sometimes so far extended as to cover the whole of the buttocks.

With regard to the physiognomy, the forehead is not high but small, and sometimes retreating ; the nose is broadly flattened out, frequently with dilated nostrils ; the mouth is broad, and has a projecting upper lip ; the chin is retreating, while strongly projecting cheek-bones strikingly contrast with the smallness of the forehead in the temporal region.

The Papuans of Maclay coast bore a hole through the septum of the nostrils, in which a long fragment of stone or piece of shell is worn. The teeth are much worn through the almost exclusive use of a vegetable diet : Dr. Maclay noticed this in his own teeth after a stay of eight months in Papua. The lobules of the ears are pierced at an early age by means of the thorn of a *Dioscorea* and become much elongated by having to support heavy ear-rings.

If the back of a Papuan is seen in profile, there will be noticed a considerable concavity of curve in the lumbar region. This would seem to be a characteristic in which the Papuan differs from the Caucasian race. The Papuans make a greater use of the left hand and arm than of the right, and use the feet to pick up various objects—sometimes very small ones—from the earth. This is done, not by flexion of the toes, but by anadduction of the great toe, which is considerably separated from the rest of the toes. From this use of the,toes, it frequently happens that the two feet are dissimilar in size.

Circumcision is performed at from the ages of 13 to 15 years, and, as Zipporah performed it, with a sharp flint. This custom is general among the Papuans of Maclay coast, and among most of the coast and some of the mountain inhabitants. Those—and among them are the New Irelanders and the inhabitants of one of the Islands of the Archipelago of Contentment—who do not use this rite are looked down upon by their circumcised brethren. The suckling of infants is carried on for a long period, sometimes to the age of four years.

The Papuans are very strict in their sexual relations. The men marry early, soon after circumcision, and have only one wife ; concubinage is almost unknown. The women, probably on account of the hard work in which they are engaged, seldom bear many children.

In spite of the dark colour of their skin, Dr. Maclay was able to recognise a change of colour in the face among the Papuans. He does not, however, state whether blushing follows upon a sense of shame, but only notices that the features are darker when they are overjoyed, or have been making great efforts, *e.g.* in the dance.

The Papuan women, like their European sisters, cultivate the art of which Mr. Turveydrop was the distinguished professor. Readers of the "Arabian Nights may remember how that the seductive wriggling of the sides of one of the damsels "shaped like the letter alif," caused the "world to turn black" before the eye of a susceptible hero, and will therefore fully appreciate the subtle influence of a peculiar and "killing" wriggle which the Papuan maid begins to have at even the tender age of seven years. The half-caste women whom one sees at Batavia seem to have adopted a similar though modified habit.

The favourite position of the Papuan men—as it seems to be among the Malays also—is resting the buttock upon the heels (*das Hocken*), while the whole surface of the soles of the feet is applied to the ground. Dr. Maclay found that he could keep his balance only when the toes alone were in contact with the earth. This position of the Papuan must not only be acquired, but must depend also upon a peculiar relation of proportion in the limbs. Nothing can be said with certainty as to the duration of life among the Papuans. Dr. Maclay never saw an old individual among them.

Dr. Maclay, from the observations which he has at present made, concludes that *the Papuan stock falls into numerous varieties, distinct from one another, which, however, have no sharp lines of demarcation.*

On December 19, 1872, some natives came to Dr. Maclay to inquire the cause of some smoke which had been seen rising from the sea between Vitias and Dampier Islands. This turned out to be the clipper *Izoumroud*, which had been sent out to look for the traveller (whose death, it seems, had been announced in the English journals), at the instance of the Grand Duke Constantine.

Early on the morning of the 24th the *Izoumroud* weighed anchor, and as she steamed away there could be heard all along the coast the sound of the Bâroem, a great wooden gong, announcing to the islanders the departure of the "man-in-the-moon," who had taken up his abode for more than a year amongst them.

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* A small marsupial found in Papua. It is figured in Wallace's "Malay Archipelago."

† The long hair worn at the back of the head is termed "gatessi."

JOHN C. GALTON

MICROSCOPIC EXAMINATIONS OF AIR

A WORK[*] of the greatest importance on the above subject has just been published in Calcutta by Mr. Douglas Cunningham. The conclusions which he has reached as the result of the experiment are so valuable that we deem it right to give them as great publicity as possible. The following is Mr. Cunningham's description of the aeroscope with which he made his experiments:—

The apparatus employed in obtaining specimens was a slightly modified form of that devised by Dr. Maddox. It consisted of three thin brass tubes, two of which slipped over the third central one and came into contact with the opposite side of a projecting rim on its circumference. This rim was formed by the margin of its diaphragm which divided the centre tube into two chambers. It was of sufficient thickness to allow of a spindle passing up through it. The latter terminated in a pointed extremity, which came in contact with the upper end of the bearing, and provided for the free rotation of the system of tubes. Round the margin of the diaphragm there was a set of perforations, to allow of the passage of air through it, and, on the centre of its anterior surface, there was a square plate of glass with a slightly projecting rim on its lower margin. The anterior of the two lateral tubes was provided with an expanded orifice, and contained a small, finely-pointed funnel in its interior; the pointed extremity opening immediately in front of the centre of the diaphragm-plate. The posterior tube was quite simple, and had a good-sized fish-tail vane fitted into a slit in its extremity.

The following are Mr. Cunningham's conclusions:—

The most important conclusions to be derived from all the preceding experiments regarding the dust contained in the atmosphere in the vicinity of Calcutta appear to be the following:—

1. The aeroscope affords a very convenient method for obtaining specimens really representing the nature of the true atmospheric dust.

2. Specimens of dust washed from exposed surfaces cannot be regarded as fair indices of the constituents of atmospheric dust, since they are liable to contain bodies which may have reached the surface otherwise than by means of the air, as well as others which are the result of local development.

3. Specimens collected by gravitation also fail to indicate the nature and amount of organic cells contained in the atmosphere, as the heavier amorphous and inorganic constituents of the dust are deposited in relative excess due to the method of collection.

4. Dew also fails to afford a good means of investigating the subject, as it is impossible to secure that all the bodies really present in a specimen of it should be collected into a sufficiently small space, and, moreover, because it is liable to accidental contaminations, and also affords a medium in which rapid growth and development are likely to take place.

5. Distinct infusorial animalcules, their germs or ova, are almost entirely absent from atmospheric dust and even from many specimens of dust collected from exposed surfaces.

6. The cercomonads and amœbæ appearing in certain specimens of pure rain-water appear to be zoospores developed from the mycelial filaments arising from common atmospheric spores.

7. Distinct bacteria can hardly ever be detected among the constituents of atmospheric dust, but fine molecules of uncertain nature are almost always present in abundance; they frequently appear in specimens of rain-water collected with all precautions to secure purity, and appear in many cases to arise from the mycelium developed from atmospheric spores.

8. Distinct bacteria are frequently to be found amongst the particles deposited from the moist air of sewers, though almost entirely absent as constituents of common atmospheric dust.

9. The addition of dry dust, which has been exposed to tropical heat, to putrescible fluids is followed by a rapid development of fungi and bacteria, although recognisable specimens of the latter are very rarely to be found in it while dry.

10. Spores and other vegetable cells are constantly present in atmospheric dust, and usually occur in considerable numbers: the majority of them are living and capable of growth and development; the amount of them present in the air appears to be independent of conditions of velocity and direction of wind; and their numbers are not diminished by moisture.

11. No connection can be traced between the numbers of bacteria, spores, &c., present in the air and the occurrence of diarrhœa, dysentery, cholera, ague, or dengue; nor between the presence or abundance of any special form or forms of cells, and the prevalence of any of these diseases.

12. The amount of inorganic and amorphous particles and other *débris* suspended in the atmosphere is directly dependent on conditions of moisture and of velocity of wind.

If these results be compared with those obtained by other observers, and detailed in the first section of this report, it will be seen that they agree very closely with those of M. Robin, only differing from them in indicating the presence of a somewhat larger number of spores than appeared in his observations. They differ almost equally from those arrived at by Pouchet and Ehrenberg. It is somewhat difficult to understand how the former observer so constantly failed to detect the presence of spores in his experiments, but there is an apparent reason for Ehrenberg's observation of the predominance of animal forms in the atmosphere. His conclusions appear to have been almost entirely founded on the results of the examination of specimens of dust not directly obtained from the air, but from surfaces on which it had been previously deposited from the air, such as leaves, tufts of moss, &c. Now, as has already been indicated, it is certainly quite unwarrantable to assume that all organisms found in such specimens existed as such in the air, or were even derived from the air in any way. All such surfaces are more or less liable to contact-inoculation; leaves and moss, for example, are liable to this through the agency of insects or birds. Moreover, with regard to many of the organisms detected in such situations, it must be recollected that there is no reason why they should not have arrived there by means of active progression over the surface. When surfaces are wet with rain, there is no reason why Tardigrades, Rotifers, Anguillulæ, and many infusoria should not travel over them from one point to another. The journey accomplished at any one time may be small, and its progress soon arrested by defective moisture; but, unless they are deprived of vitality in the interval by desiccation, they are ready for a fresh start when favourable conditions are again presented to them.

It is hardly safe to venture on the vexed questions regarding the origin of bacteria, but it may, at all events, be stated that the results of the present experiments are certainly not opposed to the belief in the transmission of these organisms in some way or other by means of the atmosphere; for they were actually observed among the particles in moist air, the addition of dry dust to putre-

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Microscopic Examinations of Air," by D. Douglas Cunningham, M.B. Surgeon H.M. Indian Medical Service (Calcutta).